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Regional Preparatory Meeting on New and Renewable Sources of Energy

Addis-Ababa, 12-16 January 1981

REPORT OF THE TECHNICAL PANEL OF EXPERTS ON BIOMASS (INCLUDING FUELWOOD AND CHARCOAL)

Addis-Ababa, 20-24 October 1980

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A. INTRODUCTION

1. Within the preparations for the United Nations Conference on New and Renewable Sources of Energy to be held in Nairobi in August 1981, the present Technical Panel of Experts on Biomass (including fuelwood and charcoal) for Africa was organized by the Economic Commission for Africa in Addis Ababa from 20 to 25 October 1980. The panel was held in conjunction with two other panels, on geothermal energy and hydropower respectively.

2. The three panels of experts were opened jointly on 20 October 1980 by the Deputy Executive Secretary of ECA. After welcoming participants, the Deputy Executive Secretary emphasized the problem of energy in Africa and the importance of the African experts' contribution as a means of ensuring the success of the above-mentioned United Nations Conference on New and Renewable Sources of Energy. He broadly reviewed new and renewable sources of energy noting that Africa had a promising future in view of the availability of new and renewable sources of energy, in particular solar energy, wind energy, geothermal energy, hydropower, biomass, etc. He stressed the potential of such sources of energy for meeting Africa's energy demands within the context of the current world energy situation. Biomass was major and vital source of energy in Africa and had a prominent role to play within the over-all economic development of African countries.

3. He expected the experts to make a significant contribution and recommendations for the formulation of African policy in the utilization of new and renewable sources of energy and in particular, biomass including fuelwood and charcoal, geothermal energy and hydropower. Concrete recommendations would serve as a solid basis for the Intergovernmental

Preparatory Meeting on New and Renewable Sources of Energy in Africa, to be held at ECA headquarters in Addis Ababa from 12 to 16 January 1981.

4. The panel was composed of 11 members from six African countries and observers from FAO, UNESCO and United Nations Headquarters. (See Annex).

5. The following officers were elected: Mr. Sola George of the Upper Volta as Chairman, Mr. Berhanu Abegas of Ethiopia as Vice-Chairman and Mr. R.P. Yonazi of the United Republic of Tanzania as Rapporteur.

B. AGENDA

6. The Panel adopted the following agenda:

1. Opening of the Panel

2. Election of officers

3. Adoption of the agenda and organization of work

4. Statements made by participants on the present status of biomass, fuelwood and charcoal utilization as sources of energy in their respective countries

5. Review of biomass, fuelwoood and charcoal potential sources of energy in Africa; availability, development, technology, research, environmental, socio-economic and financial aspects and related problems

6. Prospects for, and utilization of biogas in Africa as an alternative source of energy; problems related to methods of conversion and constraints to its utilization

7. Review of fuelwood and charcoal utilization, and their integration in the development plan of African countries with other biomass energy resources

8. Short- and long-term planning, formulation of priority programme and policies for implementation in the field of biomass development and utilization in Africa

9. Co-operation among African countries, on the one hand, and between African and other countries on the other, in the field of biomass, fuelwood and charcoal research, transfer of technology, flow of information, population sensitization, education and training, preparation of instruction manual, etc.

10. Definition of a common African policy on biomass, fuelwood and charcoal utilization, to be submitted for adoption by the Intergovernmental Meeting as an African approach to the problem during the United Nations Conference on New and Renewable Sources of Energy

11. Consideration and adoption of concrete recommendations for the expansion of biomass utilization as a source of energy and for the rational utilization of fuelwood and charcoal in Africa

12. Other matters

13. Adoption of the report of the Panel

14. Closure of the Panel

C. ACCOUNT OF PROCEEDINGS

Statements by participants (Agenda item 4)

7. It was noted that some of the economic parameters of development were land, labor, capital and energy but in the past because of its ready availability at low prices energy had been only low on the scale.

8. Energy was required in all sectors of the economy whether in the form of heat, steam, electricity, liquid transportation fuels or gaseous fuels or to produce petrochemical products.

9. Petroleum prices had increased rapidly from $US 0.75 a barrel in 1957 to over $US 35 a barrel in 1980. Those price increases in petroleum had caused major problems to both developed and developing countries. The developing countries in some cases had had to use 50 to 100 per cent of their export earnings to pay for petroleum products alone. Those increases in petroleum prices had also caused other sources of energy to increase in price. Therefore, all countries had begun to examine alternative sources of energy as possible means of meeting their energy needs. The alternative sources being considered by the United Nations Conference comprised:

- Biomass (including fuelwood and charcoal)
- Solar energy
- Wind energy
- Geothermal energy
- Hydropower
- Ocean power
- Oil shale and tar sands
- Peat
- Animal power

10. A document prepared by ECA on the subject of biomass utilization as source of energy in Africa was introduced by the representative of the

secretariat who outlined the present status of biomass utilization including fuelwood and charcoal. The document pointed out that more than 75 per cent of the African population had been using biomass as a primary source of energy and were heavily dependent on it.

11. The Kenyan expert said that fuelwood and charcoal were extremely important because in Kenya the population in rural areas was dependent on biomass for energy for cooking, heating and other purposes. Ninety per cent of Kenya's population of 15 million people lived in rural areas and depended almost exclusively on fuelwood for cooking and heating. About 80 per cent of the urban population depended on charcoal for energy. Some 75 per cent of the fuelwood and charcoal used in Kenya was ewasted because of inefficient utilization methods. The majority of the population did not buy fuelwood and where wood was scarce, people used considerably less than in areas where large quantities were available. There was a deficit of about 25 million metric tons/year in energy needs, which far exceeded the growth of production. In the absence of stocks, the Kenyan forest was systematically being depleted and people had started to use branches of trees, which were much easier to chop off than to fell the whole tree.

12. Kenya was reassessing its fuelwood supply policy to produce more fuelwood. The options were afforestation by appropriate species and thrifty consumption of fuelwood. Biomethanization had received considerable attention in the country, and was applied on a small scale.

13. The Guinean expert said that Guinea had 121 reserved forests covering 1,056,174 hectare, which represented about 4.12 per cent of the total land area. Guinea had in addition 16,100,000 hectare of wood land. Between 75 and 85 per cent of the total population of Guinea depended on agriculture. The most recent livestock statistics prepared in 1976 indicated that there were 1,204,000 head of cattle, 491,000 sheep, 56,000 pigs and around 5 millions poultry. Those figures indicated the importance of biomass as a source of energy.

14. However, the relevant technology was required in order to exploit those sources efficiently and in that regard Guinea had experimented with a few digesters of the Indian type for biogas generation. The experience so far had been quite satisfactory and efforts were being made to extend the technology to the rural areas.

15. Fuelwood and charcoal represented the principal source of energy for cooking in rural areas, which was unfortunately conducive to rapid desertification. Other alternative sources of energy such as biomass and biogas should therefore be developed as soon as possible. Hence Guinean experts were concerned with the development of integrated sources of energy such as solar, wind and biogas. The main obstacles were the aquisition of proper techniques and technology of energy utilization, and it was hoped that those technologies could be obtained for the African countries.

16. The Ethiopian exnert reported that only 2 per cent of Ethiopia's hydro-potential had been developed, but even then only 50 per cent of the generated electricity was used. The price of electrical appliances was beyond the reach of most citizens which made it difficult to persuade the population to change from firewood, which was in short supply, to electricity even where electricity was available. The forests were being depleted at the rate of 200,000 hectare per year and if the rate was not reversed, the country would be without forests in 20 years. Forests, which had covered 40 per cent of the land nearly a century ago, now covered only 4 per cent. The current charcoal supply was estimated at 150,000 metric tonnes/year. Furthermore an estimated 20 million m3 of fuelwood was consumed annually with the urban population. The urban population accounting for 1.5 million m3.

17. In order to alleviate the prevailing shortage of fuelwood and to reafforest the already depleted regions, the Ministry of Agriculture, in co-operation with an estimated 30,000 peasants associations was implementing an intensive reafforestation programme throughout the country. The National Energy Committee had established a biomass working group in 1978. The working group maintained working relationships with universities, research institutions and rural development centres and there were at present over 20 biogas digesters in operation, mostly of the Indian type. The group intended to have 12 more Chinese type digesters built during the current fiscal year. The digesters now served for demonstration pruposes and the experience gained from the building and performance evaluation of the digesters would help in recommending the most suitable type of digesters for the country. The group was also looking into ways of making biogas appliances such as burners and lanterns.

18. The Nigerian expert said that with a population conservatively estimated at 64 million in 1976, fuelwood requirements in Nigeria were enormous. There was a clearly identified shortage of wood especially in the semi-arid areas to the north of the country where nearly 50 per cent of the population lived. The semi-arid climate of the savanna regions in the north coupled with the long dry seasons and harsh environmental conditions made the productivity of the natural forest very low: from about 0.1 m3 hectare/year to about 1.0 m3 hectare/year. The already scanty vegetation was being exploited at a fast rate resulting in a rapid decline in existing forest resources. The situation was deteriorating to the extent that people now used corn shalles and cow dung as fuel, further reducing soil fertility in the areas concerned.

19. Efforts were underway to remedy the isituation. Past measures which had consisted mostly of establishing fuelwood plantations and communal wood-lots were now considered inadequate to meet future needs.

Other projects aimed at remedying the situation included:

(a) Accelerated large-scale plantation development

(b) Development of shelterbelts

(c) Establishment of a National Committee on Arid Zone Afforestation

(d) Encouragement of the habit of planting trees through tree-planting campaigns

(e) Research into the selection of fast-growing tree species and suitable techniques for their establishment in the semi-arid environment.

20. The expert from the Upper Volta said that his country essentially had no forest and was an agricultural and livestock country. More than 90 per cent of the population lived in the rural areas. The main sources of energy for those people were agricultural wastes, bush and manure for cooking and lighting. As agricultural wastes (sorghum stalks) were not sufficient during the whole year, people also used fuelwood in urban and rural areas. Charcoal was used only in cities and then on a small scale. Fuelwood and charcoal were expensive. Fuelwood was carried from rural areas to urban areas (at least 50 km) and would cost one family $US4 for two meals a day.

21. Deforestation had become a serious problem in the Upper Volta and the Inter-African Committee for Hydraulic Studies (ICHS had undertaken a series of experiments on biomass conversion, particularly on biogas technology.

22. Considering the conditions in the Upper Volta, the batch system for biogas generation was being investigated. The system has a 50-day cycle which used less water for methanization. Two stages were used in the methanization process:

(a) Pretreatment of agricultural wastes and cow dung,

(b) Anaerobic stage on digestion process.

The digester was charged with 75 kg of agricultural wastes, 25 kg of cow dung and 300 litres of water per m3 of volume. Gas production averaged 300 litres per m3 of digestion. The gas had been used for cooking, lighting and running engines. The Indian-type burner and lamps, and Bernard motor were the equipment used. Gas consumption requirements had been found to be 0.34 m3/person day for cooking 0.125m3/hr for an equivalent of 100 watts lamp for lighting, and 0.515 m3/Hp hour for power. The calorific value of the gas produced was 4770 kcal/m3. Digesters of Indian type had a volume of 4 m3 each, and were constructed of concrete. The cost was $US800 per digester, while the Chinese digester costs $US750. The cost of the digester thus seemed to be very high for a peasant in the Upper Volta. ICHS, in collaboration with the General Office of Scientific Research of the Upper Volta was trying to find out an economic way to reduce the digester cost. Biomass conversion into biogas would not be economical if fertilizer was not taken into account.

23. The Tanzanian expert said that fuelwood in the United Republic of Tanzania was the major source of energy for domestic and industrial use, including tobacco processing and brick baking. More than 70 per cent of the energy utilized in the country came from fuelwood and charcoal. Per capita consumption of biomass including fuelwood and charcoal would be 1.75 m3/year by 1985 and the forecast for the year 2000 was 1.33/m3 year. Firewood and charcoal demand was estimated at 36 million m3 per year of which the urban areas accounted for about 0.8 million m3 per year. The principal industrial usage is for drying tobacco which required 2.1 million m3/year.

24. Current statistics indicated that the total demand of wood for fuel was 27 million m3 per year while the sustained yield was only 17 million m3 per year. The country was facing problems in that the charcoal demand was increasing. A 7-ton truck with 200 bags of charcoal would earn $US2,000. The rough sawn lumber on a 10-ton truck sold at about $4,000 for fine hardwoods such as Pterocarpub angolensis. These high prices encouraged more rapid deforestation. In addition shifting cultivation removed a substantial portion of the forests every year.

Biomass potential in Africa (agenda item 5)

25. As pointed out in the statements by the participants biomass represented a major source of energy throughout Africa, particularly in the form of firewood or charcoal. In those regions where forests did not exist agricultural residues and animal manure were used. Biomass availability varied from region to region. Reforestation programmes were under way throughout Africa to increase supplied of timber, pulp wood, and fuelwood.

26. The Panel noted that Africa depended heavily on agricultural and forest residues (manure, wheat and rice straw, maize stalks, baggasse, prunings, cuttings, bark and saw dust) municipal and industrial solid wastes and sewage sludge. Some experts also classified peat as a biomass source for which a small amount of new material was produced each year. Biomass and wastes could be used to produce heat, electricity, steam, liquid and gaseous fuels, including synthetic petroleum and oils, gas of low, intermediate or high caloric value and other energy-intensive materials such as petrochemical substitutes and fertilizers.

27. Since biomass was a renewable source of energy and was the precursor of coal and oil it had received increasing attention as a possible means of supplying a larger portion of Africa's energy needs.

28. The Panel classified vegetation as either terresterial or aquatic. Terresterial growth was composed of woody biomass crops - typically short rotation tree crops, herbaceous crops and standing forest biomass (e.g. cull trees and non-commercial stands). Aquatic growth included fresh-water, brackish-water and marine algae and aquatic plants.

29. Wastes were defined as those materials which must be disposed of at a cost to the user (urban solid wastes, sewage and the waste products of manufacturing).

30. Residues or secondary raw materials) were all delivered to the energy conversion unit or to the consumer at a cost. They were more homogeneous than wastes. Because of the differences between wastes and residues different conversion systems were often required. Traditional forestry practices had been directed toward species which produced structural timber and pulp with some residues which could be made available for energy purposes. Those stands were being maintained but consideration should be given to maximum biomass production.

31. Participants pointed out that for short rotation forestry where species selection was important intensive efforts should be made to screening and selecting species which could be grown on marginal lands with limited water and yet give maximum yields.

32. The Panel reviewed the needs for liquid transportation fuels. It was recognized that biomass was the one renewable source for these fuels. There were a number of processes either available commercially or under development. They included the fermentation of sugar crops and grains where the problem of food verses fuel might limit the use of feedstock for alcohol production. The conversion system varied from open fires, stoves furnaces, or direct combustion units to produce heat, steam and electricity.

33. Biomethanization was beginning to be used and many of the countries were carrying out R and D activities.

34. Participants pointed out the necessity to study the economic aspects of biomass utilization in close co-operation with economic, social and scientific personnel from the region.

35. For biomass conversion systems used by the homeowner, farmer or small rural village, the cost of the energy could not be conceived in the same manner as for large scale systems. The individual might interprete biomass residue cost as what the removal cost him in terms of productivity if the residue was not returned to the soil. In the case of fuelwood the farmer might think in terms of the opportunity-cost of growing wood. The only cost reported might be the cost of purchased material. On the other hand some farmers or co-operatives might consider the cost of equipment, labour to build and operate the facility, the funds borrowed to purchase the materials as well as the materials of the feedstock unit costs. The feedstock cost might be established by determining the return that could be obtained from alternative uses of biomass. Great care was thus needed when assessing the costs of small-scale systems to be sure they all included the same factors.

Biomethanization (biogas) in Africa (agenda item 6)

36. Biomethanization to produce methane and carbon dioxide was one of the most attractive means of providing heat, light, electricity and mechanical energy. In addition it had an advantage over direct combustion in that the nutrients could be recycled in the soil.

37. Biomethanization involved the decomposition of organic matter in the absence of oxygen to produce methane. Manure, agricultural residues, sewage, paper, seaweed, algae, etc. could be used to produce methane gas. The current process used mainly animal manure and human refuse as a feedstock. The biomethanization process was not new. Natural gas, swamp gas and the gas from anaerobic lagoons were examples of natural biomethanization processes. The first known application of the process had taken place in the United Kingdom in 1895 to provide gas for street lighting.

38. Some of the attractive features of biogas generation by biomethanization included the use of manure to produce gaseous fuel (a mixture of methane and carbondioxide). It eliminated pathogenic organisms (disease-causing bacteria), thereby helping in the control of diseases. The fertilizer value of the feed to the digester was enhanced after biomethanization. The residue from the process was a combination of dead anaerobic bacteria and undigested solids and had a higher protein value than the feedstock. The methane produced could be used in stove burners, for lighting purposes, to run stationary engines such as generators, irrigation pumps, fueling vehicles, refrigerators, etc.

39. Ethiopia, Guinea, Kenya the Upper Volta, the United Republic of Cameroon and other countries all had active research, development and demonstration programmes. There were some commercial units operating. The primary feedstock was animal manure which in some cases was supplemented with agricultural residues.

40. Attention now focused on increasing production of the gas and reducing the capital costs of the digesters, as well as adopting the design to local conditions and using locally available materials.

41. The major constraints to the wider adoption of the technology were the capital costs and supporting structure. It was noted that the most successful programme was that of China where low cost units had been developed and support staff was available to assist in building and operation.

Fuelwood and charcoal utilization (agenda item 7)

42. In the management of forests for fuelwood production, very many benefits could be obtained, some of which were of great value. Priorities must be given to woodfuel production even in cases where the price of imported fuels such as kerosene might be acceptable to farmers, since in future the price of imported kerosene was likely to be high when compared with fuelwood and charcoal.

Short- and long-term priorities (agenda item 8)

43. Any short- or long-term planning should be preceeded by an accurate analysis of the existing situation. It was therefore important to assess the current supply/demand and available biomass resources. The existing use of various forms of energy along with future trends of energy usage (consumption) would have to be determined in order to drawing a rational and meaningful short- and long-term plan for any given country.

44. Many African countries not only did not know how their land was being used but had no land use plan. Therefore a short-term goal was to develop land use information.

45. In planning it was important that adequate information should be available to trained personnel so that the options could be reviewed prior to the formulation of any policy.

46. Better use should be made of forest reserves through consumption priorities and the introduction of stoves. Forest areas which harvested each year should be replanted.

Short-term

47. Education and training should be introduced stressing the use of the most efficient and lowest cost system through schools and mass-media programme.

Long-term

48. New low cost efficient conversion systems for cooking and heating should be developed.

49. A screening programme of fast growing high yielding species which could be used in Africa should be initiated. National and inter-regional reforestation programmes should be introduced using species selected from the screening programme.

Co-operation (agenda item 9)

50. The participants stressed that any co-operation programme to be established should cover:

(a) Information flows on African experience,

(b) Technical assistance through the transfer of technology among member States,

(c) Joint projects among neighbouring States in biomass research and development in which experts and technicians would be involved at both the training and the execution levels.

African policy (agenda item 10)

Proposed introductory statement

51. Biomass played and would continue to play a major role in supplying the energy needs of the continent. African had two primary needs for energy: for survival and for development.

52. African countries needed to examine their current and projected energy future uses carefully. Reviews should involve rural prepresentation to assure that any proposed changes would satisfy the social and environmental needs of the rural people.

D. Recommendations (agenda item 11)

53. The Panel realized that biomass was scarce in many parts of the continent and that alternative sources of energy such as oil and natural gas, which were also scarce and expensive, were also non-renewable. African countries should re-assess their energy options.

Planning

54. For energy planning the following recommendations were made:

(a) Current and projected energy consumption by sector and the means to meet those needs should be determined,

(b) Each country should be encouraged to develop land use plans which would indicate those areas that might be available for the production of biomass for energy purposes,

(c) The planning process should involve the users to ensure that their needs were taken into consideration.

Research and development

55. The African Biomass Committee (see below paragraph 60) should follow research, development and demonstration activities. For those areas which appeared to be promising but for which insufficient funds were available the committee should request financial support.

Education and training

56. Education and training were of primary importance in the development and implementation of the biomass system. The Panel recommended the following:

(a) Utilization of the existing universities, technical schools, and training centres to produce skilled personnel,

(b) Emphasis on on-the-job training for technicians and extension agents,

(c) Development of programmes for specialized areas in the field of biomass production and conversion,

(d) Organization of seminars, workshops, conferences in specific areas of scientific and technological interest related to biomass,

(e) Greater utilization of United Nations educational and training programmes,

(f) Development of public information programmes which could be used to inform the public and sensitize it to energy problem so as to make it aware of the developments taking place in the utilization of biomass.

Production of biomass

57. The following recommendations were made concerning production:

(a) Existing sources of biomass should be utilized in the most efficient ways possible to minimize wastes in both material and energy by the use of simple and inexpensive cooking stoves,

(b) Forest exploitation practices in wood-rich areas within each country should take into account the scarcity of fuelwood in other parts of the country,

(c) Large-scale afforestation programmes should be undertaken especially in semi-arid and other wood-deficient areas,

(d) In semi-arid regions consideration should be given to growth of drought resistant species which could be used for energy purposes,

(e) Indepth research should be conducted on the suitability of various fast-growing and drought-resistant species for use in biomass programmes,

(f) Agroforestry should be introduced as a means of increasing productivity of both fuelwood and agricultural crops.

Biomethanization (biogas)

58. The Panel realized that biomethanization represented one method of producing energy in rural areas. African countries should:

(a) Develop the required infrastructre to use biomethanization,

(b) Develop low cost gas storage systems,

(c) Develop low cost gas appliances that could be manufactured using mass production techniques,

(d) Investigate the availability of low cost materials that could be used to build digesters.

Combustion

59. Combustion was a widely used technology but the following needs were recognized:

(a) Direct combustion systems which were low cost and efficient should be developed. They should be constructed from local materials,

(b) The use of biomass fuels in direct combustion systems should be encouraged as a replacement for petroleum fuels.

Information flow

60. The Panel recommended the establishment of an African Biomass Committee which would meet annually to recommend plans of action for Africa. The plans would be updated annually. At least two sub-groups should be established, one dealing with production and the second with conversion facilities. The African Biomass Committee should have as one of its main functions to ensure that the activities of all African countries were fed into the information system.

Financial incentives

61. Certain financial barriers appeared to impede the utilization of improved biomass systems. Consideration should be given to the means to overcome these barriers through a) low cost loans, b) loan guaranties, and c) tax incentives.

Other matters (agenda item 12)

62. No questions were raised under this item.

Adoption of the report of the Panel (agenda item 13)

63. After considering and amending the draft report prepared by the Drafting Committee, the meeting adopted the report and recommendations.

Closure of the Meeting (agenda item 14)

64. Following the adoption of the report and recommendations the Chairman declared the panel of experts on biomass closed. The final closing ceremony for all the three panels then took place.

Annex

LIST OF PARTICIPANTS/LISTES DES PARTICIPANTS

Mr. R.P. Yonazi
Senior Forestry Officer
Forestry Department
Ministry of Natural Resources
P.O.Box 426
Dar Es Salaam
Tanzania

Mr. D.M. Kamweti
Conservator of Forests
Forest Department
P.O.Box 30513
Nairobi
Kenya

Mr. Sola Georges
Specialiste Biogas au CIEH
CIEH
P.O.Box 369
Ouagadougou
Haute-Volta

Mr. Mesele Seyum
Engineer
Ethiopian National Energy
Committee
Ministry of Mines, Energy
and Water Resources
P.O.Box 486
Addis Ababa
Ethiopia

Mr. Teshager Haile Mariam
Ministry of Agriculture
P.O.Box 1232
Addis Ababa
Ethiopia

Dr. Berhanu Abegaz
Assistant Professor
Addis Ababa University
P.O.Box 1176
Addis Ababa
Ethiopia

Mr. Beyene Megersa
Head
Agricultural Engineering Section
Arsi Rural Development Unit
P.O.Box 3376
Addis Ababa
Ethiopia

Mr. Theodros Solomon
Assistant Professor
Addis Ababa University
P.O.Box 1176
Addis Ababa
Ethiopia

Mrs. Zelleka Getahun
Chemist
National Energy Committee
Addis Ababa
Ethiopia

Mr. Ousmane Souare
Directeur
Division Sciences Exactes
et de la Nature
I.N.R.D.G.
B.P. 561
Conakry
Rep. Pop. de Guinee

Mr. Atthew Ogiririgi
Chief Scientific Officer
Forestry Research Institute of Nigeria
Shelter Belt Research Station
Kano
Nigeria

Observers/Observateurs

Mr. Abuella Abdenaser
UNESCO Representative
UNESCO - ROSTA
P.O.Box 30592
Nairobi
Kenya

Mr. Martin L.S.B. Rukuba
Regional Advisor
ECA/FAO Forest Industry
Addis Ababa

Secretariat/Secretariat

Mr. Roscoe Ward
United Nations Headquarters
New York, N.Y. 10017
U.S.A.

Prof. I. Sakr
Energy Resources Unit, NRD
P.O.Box 3001
ECA
Addis Ababa
Ethiopia